SOLAR/2003-79/05

Monthly Performance Report

SCATTERGOOD SCHOOL

MAY 1979

U.S. Department of Energy

National Solar Heating and Cooling Demonstration Program

National Solar Data Program

MONTHLY PERFORMANCE REPORT
SCATTERGOOD SCHOOL
MAY 1979

I. SYSTEM DESCRIPTION

A solar energy system is installed at Scattergood School near Westbranch, which is located 35 miles southeast of Cedar Rapids, Iowa. The system is designed to supply approximately 75 percent of the annual space heating requirements for the gymnasium, as well as 75 percent of the hot water for the student locker room. This solar energy system is also used to dry grain in a modified grain silo located on the site adjacent to the gymnasium. The site has an array of 128 flat-plate collectors, manufactured by Solaron, with a gross area of 2,496 square feet. The collectors face south at an angle of 50 degrees from the horizontal. Collected solar energy is stored in a pebble bed containing 64 tons of stones for space heating and in two 120-gallon tanks to permit DHW preheating. Air is the medium used for transferring energy from the collector array to the pebble bed or directly to the gymnasium.

When solar energy is insufficient for space heating, two 250K Btu propane gas heaters furnish auxiliary energy. Auxiliary heating for hot water is provided by a 52-gallon domestic water heater containing standard electric resistance, immersion heater elements. The solar energy system is manually converted to summer mode operation by opening and closing slide gate dampers which isolate the storage from the solar energy system. The control system switch then is positioned to the summer mode.

The system, shown schematically in Figure 1, has five modes of solar operation.

Mode 1 - Collector-to-Space Heating: This winter mode is entered when two conditions occur simultaneously. The first condition occurs when the collector outlet temperature exceeds the gymnasium temperature by at least 45°F. The second condition occurs when there is a space heating

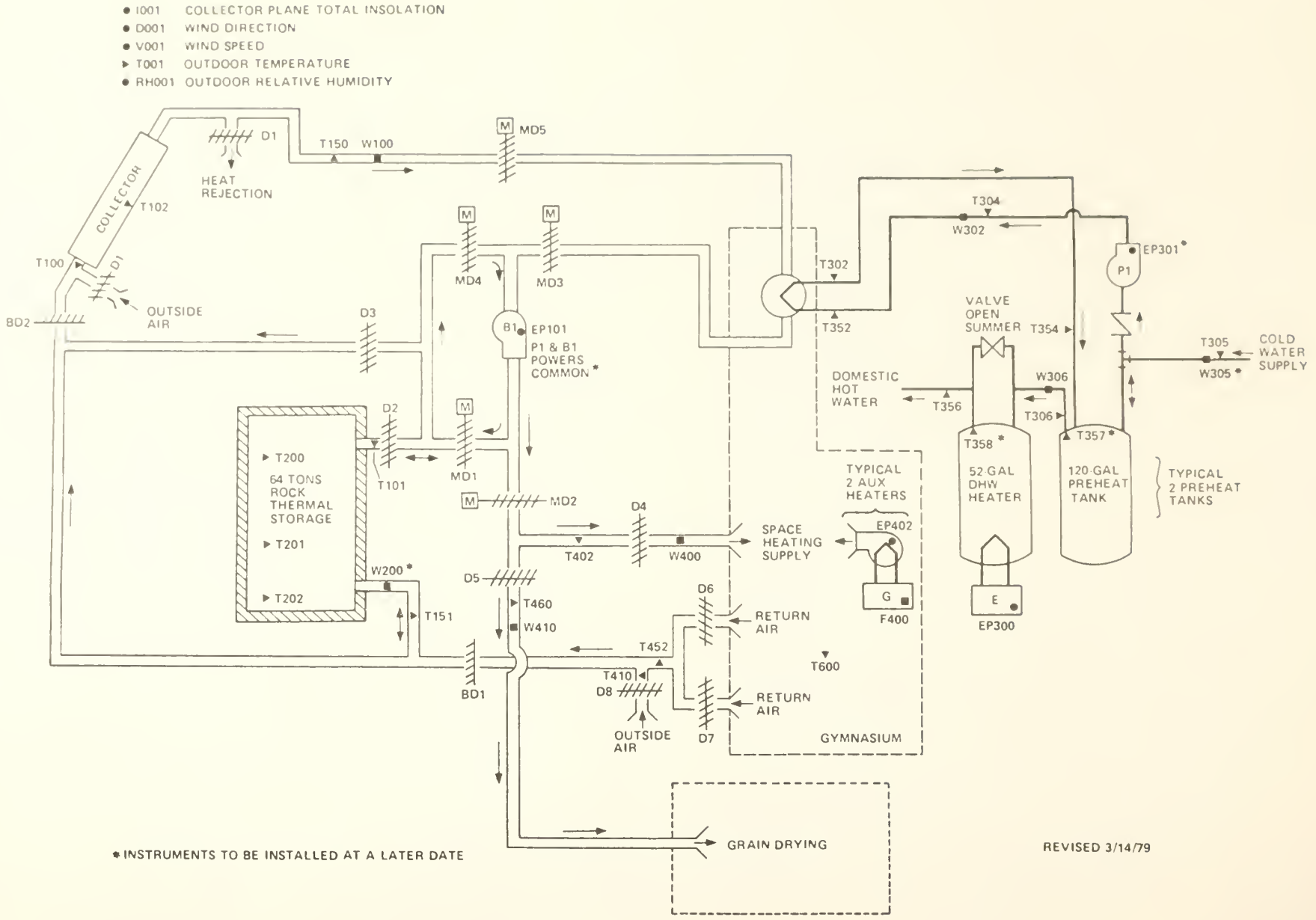

Figure 1. SCATTERGOOD SCHOOL SOLAR ENERGY SYSTEM SCHEMATIC

demand indicated by the manually preset, two-stage thermostat. The air heated by the collector is circulated by the air-handling unit between the collector and the gymnasium through ducts containing motorized dampers. In this mode, the heated air bypasses the rock thermal storage as it returns to the collector. This mode continues until either the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F, or the demand for space heating is satisfied. Stage one of the thermostat operates when solar energy is needed, and stage two operates in conjunction with stage one to activate the auxiliary heaters to supplement solar energy when the gymnasium temperature drops below a level determined by the thermostat setting.

Mode 2 - Storage-to-Space Heating: This winter mode is entered when these three conditions occur simultaneously: 1) there is a demand for space heating, 2) the collector loop is not active, and 3) the temperature in the rock thermal storage is 90°F or higher. Air is drawn through the ducts from storage and circulated through the air-handling unit to the conditioned space and returned to storage; the air bypasses the collector.

Mode 3 - Collector-to-Storage: This winter mode is entered when the collector outlet temperature exceeds the gymnasium temperature by at least 45°F, and Mode 1 is not required. Heated air is drawn from the collectors, via the air-handling unit, and is circulated between rock thermal storage and the collectors. This mode continues until the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F.

Mode 4 - Collector-to-Water Preheating: This summer operation mode is entered when two conditions are met. The first condition is that there is a request for hot water. The second condition occurs when the collector outlet temperature exceeds the gymnasium temperature by 45°F. Heated air drawn from the collector is circulated via the air-handling unit through the ducts past an air-to-liquid heat exchanger and returned

to the collector (the air bypasses the rock thermal storage). Simultaneous to collector air flow, pump P1 is turned on and DHW preheat tank water is circulated through the air-to-liquid heat exchanger, where solar energy is obtained and used to increase the temperature of the DHW preheat tank. This mode continues until the temperature in the preheat tanks reaches 140°F, or until the collector outlet temperature no longer exceeds the collector inlet temperature by at least 30°F. This preheated water is stored in two 120-gallon tanks and delivered on demand to the 52-gallon DHW heater. Water can also be preheated in Modes 1 and 3 during the heating season, when energy collection is occurring and a hot water demand exists.

Mode 5 - Grain Drying: This manually controlled winter mode is utilized to reduce the moisture of grain stored in a bin near the gymnasium. This mode operates in the fall and spring to utilize excess solar energy. Manual dampers D8 and D5 (Figure 1) are opened, and manual dampers D4, D6 and D7 are closed. This action provides a path for outside air to be drawn by the air-handling unit through the collectors, where it is heated, and then supplied to the grain bin. The mode is entered by raising the gymnasium thermostat to artificially produce a demand for space heating to the control system. The mode is terminated manually either after solar energy is exhausted, or after the grain reaches the desired dryness.

II. PERFORMANCE EVALUATION

The system performance evaluations discussed in this section are based primarily on the analysis of the data presented in the attached computer-generated monthly report. This attached report consists of daily site thermal and energy values for each subsystem, plus environmental data. The performance factors discussed in this report are based upon the definitions contained in NBSIR 76-1137, Thermal Data Requirements and Performance Evaluations Procedures for the National Solar Heating and Cooling Demonstration Program.

A. Introduction

During May, the Scattergood School solar energy system operated in the winter space heating modes. The system furnished 97 percent of the 14.34 million Btu required to satisfy the combined space heating and hot water demand. The operation of these subsystems resulted in a savings of 22.6 million Btu of fossil fuel energy (247 gallons of propane) at an expense of 0.33 million Btu of electrical energy (97 kwh).

B. Weather

The insolation available on the collector array during the month was an average of 1,549 Btu/ft^2-day, which is near the 1,504 Btu/ft^2-day estimated for the month. This estimate is computed by using an algorithm to estimate the insolation on a tilted surface from long-term insolation data (on a horizontal surface) obtained from SOLMET Volume 1 - User's Manual. The horizontal insolation data from Des Moines, Iowa and Moline, Illinois were used to estimate the horizontal insolation for Westbranch, Iowa.

The average measured outside ambient temperature was 61°F, which is the long-term prediction from the average of Des Moines, Iowa and Moline, Illinois temperature data obtained from Climatography of the United States No. 81 (By State).

C. System Thermal Performance

Collector - Of the 119.88 million Btu of incident solar energy on the collector array during May, 64.88 million Btu were incident on the array when the collector was operating. The system collected 24.27 million Btu, or 20 percent of the available insolation at an expense of 0.33 million Btu of electrical operating energy. The system collected 37 percent of the insolation available during collector operation.

From collected energy, 2.91 million Btu were delivered to the hot water preheat tanks, 6.38 million Btu were delivered to storage, and 7.44 million Btu were delivered directly to the loads. Consequently, there was an indicated loss of approximately 7.55 million Btu from the transport loops in the subsystem.

Storage - The rock thermal storage subsystem received 6.38 million Btu of collected solar energy. The subsystem furnished 6.13 million Btu to meet the space heating demand. The energy imbalance indicated between the energy delivered to storage, the energy extracted from storage and change in rock bed energy is believed to be due to temperature bias error associated with the rock bed temperatures. This condition results in an indicated energy gain of 0.72 million Btu and a rock bed efficiency of 111 percent. This condition will be checked when the temperature sensor weather heads are removed and the temperature sensors recalibrated during a planned visit in July.

Domestic Hot Water Load - Hot water consumption for the month was 1,207 gallons, or 39 gallons per day. The hot water load was 0.78 million Btu, of which 40 percent was supplied by solar energy. In order to satisfy this load and to maintain the DHW supply at an average temperature of 131°F, 4.35 million Btu of thermal energy were supplied to the DHW and preheat tanks. The difference between the energy added to the tanks and the hot water load are thermal losses from the DHW subsystem. The total thermal loss from the subsystem was 3.58 million Btu. The 4.35 million Btu of energy transferred to the DHW heater and two preheat tanks were comprised of 2.91 million Btu of solar energy, and 1.44 million Btu of auxiliary thermal energy supplied to the DHW heater. A septic tank failure at the boy's dormitory necessitated increased use of the domestic hot water subsystem in the recreation center. This increased usage resulted in a performance increase of the subsystem during the month.

Space Heating Load - To maintain an average indoor temperature of 73°F for the gymnasium, the solar energy system at Scattergood School provided 97 percent of the indicated space heating demand of 13.57 million Btu.

The space heating demand for May was expected to be 5.85 million Btu. However, the actual space heating demand was 13.57 million Btu. The discrepancy between the expected and actual space heating demands is due to excess solar energy contributions to the gymnasium. A motorized damper leak and natural convection transfer of energy from rock storage are the sources of the excess solar heating. This condition is discussed in detail in the observation section of this report.

D. Observations

The large transport loop energy losses may be caused by leakage through manual slide dampers. The leaky dampers could result from inadequate sealing of the manual dampers after the solar energy system was converted from the summer to winter operation in October 1978, and from grain drying operation to space heating in November 1978. Another source of transport loop leakage is the collector plenums. As the system ages, the connections between the collectors and the plenums may begin to leak. An investigation will be performed to ascertain the cause of the collector transport leaks during checkout of the additional measurement sensors to be installed next month.

The excess solar energy delivered to the gymnasium was caused by two situations. First, the solar system was operated generally in the storage and hot water preheating modes due to the lack of a space heating load during the month. In the hot water or rock storage heating modes, a 12 percent leak rate in motorized damper MD-2 allowed energy to be transferred to the gymnasium. During these periods, the gymnasium temperature rises to approximately 80°F. An average gymnasium temperature of 73°F illustrates the effect of the leak. This condition resulted in the transfer of 7.3 million Btu to the gymnasium, which alone was more than sufficient to satisfy the heating demand for this month.

A second source of solar energy results from a continuous low-level natural convection transfer of energy from the rock thermal storage to the gymnasium. The natural convection flow results from a chimney effect produced by the combined effects of a tall gymnasium, cold gymnasium temperatures, and a hot storage which by design is open to the gymnasium when the solar energy system is de-energized. This condition resulted in the transfer of 5.98 million Btu to the gymnasium.

To create habitable conditions in the gymnasium, a propeller exhaust fan in combination with an open gymnasium access door was utilized to remove excess energy in the gymnasium. Thus, additional energy was utilized to run the propeller fan during the summer because of the excess solar energy added to the site.

The leaky motorized damper MD-2 should be adjusted to eliminate the air leak to the gymnasium and the rock thermal storage bypassed to prevent the excess thermal energy transfer to the building during the summer months.

E. Energy Savings

Solar energy space heating savings were 22.60 million Btu of fossil energy (247 gallons of propane) that was obtained at an expense of 0.33 million Btu of electrical energy. The low space heating operating expense is the result of two factors. First, a continuous low-level natural convection transfer of energy exists from the rock thermal storage to the gymnasium. Second, during the day when the solar energy system is heating hot water, a 12 percent leak rate in motorized damper MD-2 (Figure 1) is allowing solar energy to be transferred to the building. This reduces the requirement for controlled transfer using the circulation fan, thus reducing the operating expense.

Energy savings calculations are based on a comparison of the energy requirements of a conventional propane-fired furnace, with an assumed burning efficiency of 60 percent, to the requirements of the solar energy system.

The hot water subsystem operation resulted in an electrical energy savings of 0.321 million Btu (94 kwh). The increased savings were accrued because of an increased hot water load this month. The energy saving calculations are based on a comparison of the projected energy requirements of a conventional electrical hot water tank to the energy requirement of the solar energy system. All energy requirements are based on the measured demand for hot water.

III. ACTION STATUS

Instrumentation designed to measure more accurately the hot water subsystem performance and to measure storage subsystem air flow has been specified. These additional sensors, along with the Materials Assessment Program package, have been sent to the site. Installation of the sensors, orginally scheduled to occur in mid-April, has been tentatively rescheduled for early July. Sensor checkout and data system refurbishment will occur in July.

Grain drying air flow sensor W410 is inoperative. The sensor will be repaired in conjunction with the checkout of the additional instrumentation to be installed.

Storage return temperature sensor T151 and hot water heat exchange temperature T304 have malfunctioned numerous times since November 1978. During these periods, measurement T202 was substituted for measurement T151 and T352 substituted for T304. Sensors T151 and T304 will also be repaired during checkout of the additional instrumentation scheduled to be installed.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

SITE/SYSTEM DESCRIPTION:
SCATTERGOOD IS A HIGH SCHOOL WITH AN ENROLLMENT OF
SIXTY STUDENTS. THE SOLAR SYSTEM PROVIDES HEAT AND HOT WATER FOR A
7,966 SQ.FT. GYMNASIUM. THE SYSTEM UTILIZES AIR AS THE CIRCULATING HEAT T
TRANSFER MEDIUM AND A 62 TON PEBBLE BED FOR STORAGE. AUXILIARY HEATING S
IS PROVIDED BY TWO 250K BTU AND ONE 100K BTU PROPANE HEATERS. HOT WATER
AUXILLIARY IS A 4.5KW ELECTRIC ELEMENT IN THE DOMESTIC HOT WATER TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	119.884	MILLION BTU
	48031	BTU/SQ.FT.
COLLECTED SOLAR ENERGY	24.265	MILLION BTU
	9722	BTU/SQ.FT.
AVERAGE AMBIENT TEMPERATURE	61	DEGREES F
AVERAGE BUILDING TEMPERATURE	73	DEGREES F
LOSS SOLAR CONVERSION EFFICIENCY	0.14	
LOSS OPERATING ENERGY	0.633	MILLION BTU
TOTAL SYSTEM OPERATING ENERGY	0.899	MILLION BTU
TOTAL ENERGY CONSUMED	26.683	MILLION BTU

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.777	13.567	N.A.	14.343 MILLION BTU
SOLAR FRACTION	40	100	N.A.	97 PERCENT
SOLAR ENERGY USED	2.913	13.558	N.A.	16.471 MILLION BTU
OPERATING ENERGY	0.248	0.018	N.A.	0.899 MILLION BTU
AUX. THERMAL ENERGY	1.439	0.000	N.A.	1.439 MILLION BTU
AUX. ELECTRIC FUEL	1.439	N.A.	N.A.	1.439 MILLION BTU
AUX. FOSSIL FUEL	N.A.	0.000	N.A.	0.000 MILLION BTU
ELECTRICAL SAVINGS	0.321	-0.018	N.A.	-0.330 MILLION BTU
FOSSIL SAVINGS	N.A.	22.597	N.A.	22.597 MILLION BTU

SYSTEM PERFORMANCE FACTOR: 1.842

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT
OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978,
SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SITE SUMMARY

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

SITE/SYSTEM DESCRIPTION:
SCATTERGOOD IS A HIGH SCHOOL WITH AN ENROLLMENT OF SIXTY STUDENTS. THE SOLAR SYSTEM PROVIDES HEAT AND HOT WATER FOR A 7,966 SQ.FT. GYMNASIUM. THE SYSTEM UTILIZES AIR AS THE CIRCULATING HEAT T TRANSFER MEDIUM AND A 62 TON PEBBLE BED FOR STORAGE. AUXILIARY HEATING S IS PROVIDED BY TWO 250K BTU AND ONE 100K BTU PROPANE HEATERS. HOT WATER AUXILLIARY IS A 4.5KW ELECTRIC ELEMENT IN THE DOMESTIC HOT WATER TANK.

GENERAL SITE DATA:

INCIDENT SOLAR ENERGY	126.478	GIGA JOULES
	545435	KJ/SQ.M.
COLLECTED SOLAR ENERGY	25.600	GIGA JOULES
	110399	KJ/SQ.M.
AVERAGE AMBIENT TEMPERATURE	16	DEGREES C
AVERAGE BUILDING TEMPERATURE	23	DEGREES C
ECSS SOLAR CONVERSION EFFICIENCY	0.14	
ECSS OPERATING ENERGY	0.667	GIGA JOULES
TOTAL SYSTEM OPERATING ENERGY	0.948	GIGA JOULES
TOTAL ENERGY CONSUMED	28.151	GIGA JOULES

SUBSYSTEM SUMMARY:

	HOT WATER	HEATING	COOLING	SYSTEM TOTAL
LOAD	0.819	14.313	N.A.	15.132 GIGA JOULES
SOLAR FRACTION	40	100	N.A.	97 PERCENT
SOLAR ENERGY USED	3.073	14.304	N.A.	17.376 GIGA JOULES
OPERATING ENERGY	0.261	0.019	N.A.	0.948 GIGA JOULES
AUX. THERMAL ENG	1.519	0.000	N.A.	1.518 GIGA JOULES
AUX. ELECTRIC FUEL	1.519	N.A.	N.A.	1.519 GIGA JOULES
AUX. FOSSIL FUEL	N.A.	0.000	N.A.	0.000 GIGA JOULES
ELECTRICAL SAVINGS	0.339	-0.019	N.A.	-0.348 GIGA JOULES
FOSSIL SAVINGS	N.A.	23.839	N.A.	23.839 GIGA JOULES

SYSTEM PERFORMANCE FACTOR: 1.842

* DENOTES UNAVAILABLE DATA
@ DENOTES NULL DATA
N.A. DENOTES NOT APPLICABLE DATA

REFERENCE: USER'S GUIDE TO THE MONTHLY PERFORMANCE REPORT OF THE NATIONAL SOLAR DATA PROGRAM,FEBRUARY 28,1978, SOLAR/0004-78/18

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENERGY COLLECTION AND STORAGE SUBSYSTEM (ECSS)

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	AMBIENT TEMP DEG-F	ENERGY TO LOADS MILLION BTU	AUX THERMAL TO ECSS MILLION BTU	ECSS OPERATING ENERGY MILLION BTU	ECSS ENERGY REJECTED MILLION BTU	ECSS SOLAR CONVERSION EFFICIENCY
1	2.548	47	0.316	N	0.010	N	0.124
2	0.383	53	0.105	O	0.000	O	0.273
3	4.966	50	0.583	T	0.040	T	0.117
4	5.158	50	0.749		0.040		0.145
5	4.595	56	0.681	A	0.026	A	0.148
6	4.659	63	0.696	P	0.029	P	0.149
7	4.223	68	0.650	P	0.025	P	0.154
8	3.814	76	0.541	L	0.022	L	0.142
9	4.317	76	0.638	I	0.032	I	0.148
10	3.866	74	0.669	C	0.026	C	0.173
11	1.444	46	0.381	A	0.001	A	0.264
12	5.222	52	0.801	B	0.040	E	0.153
13	4.800	58	0.389	L	0.000	L	0.081
14	2.823	57	0.312	E	0.000	E	0.111
15	5.012	58	0.225		0.000		0.045
16	4.439	61	0.145		0.000		0.033
17	4.221	72	0.443		0.029		0.105
18	2.949	69	0.424		0.018		0.144
19	4.576	63	0.733		0.037		0.160
20	4.772	61	0.473		0.009		0.099
21	5.073	56	0.767		0.036		0.151
22	3.825	61	0.382		0.002		0.100
23	2.598	56	0.520		0.021		0.200
24	4.376	56	0.719		0.039		0.164
25	5.148	58	0.758		0.038		0.147
26	1.411	55	0.451		0.000		0.319
27	5.117	62	0.721		0.024		0.141
28	4.983	69	0.699		0.025		0.140
29	3.009	70	0.611		0.027		0.203
30	3.982	75	0.573		0.027		0.144
31	1.579	63	0.317		0.010		0.201
SUM	119.884	-	16.471	N.A.	0.633	N.A.	-
AVG	3.867	61	0.531	N.A.	0.020	N.A.	0.137
NBS ID	G001	N113			G102		N111

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
COLLECTOR ARRAY PERFORMANCE

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

DAY OF MONTH	INCIDENT SOLAR ENERGY MILLION BTU	OPERATIONAL INCIDENT ENERGY MILLION BTU	COLLECTED SOLAR ENERGY MILLION BTU	DAYTIME AMBIENT TEMP DEG F	COLLECTOR ARRAY EFFICIENCY
1	2.548	0.656	0.347	50	0.136
2	0.383	0.000	0.000	54	0.000
3	4.966	4.420	2.100	54	0.423
4	5.158	4.578	1.786	58	0.346
5	4.595	2.993	0.892	63	0.194
6	4.659	3.483	1.038	71	0.223
7	4.223	2.664	0.823	75	0.195
8	3.814	2.059	0.670	81	0.176
9	4.317	3.154	0.968	82	0.224
10	3.866	2.700	0.859	82	0.222
11	1.444	0.030	0.025	46	0.017
12	5.222	4.552	1.740	58	0.333
13	4.800	0.000	0.000	66	0.000
14	2.823	0.000	0.000	60	0.000
15	5.012	0.000	0.000	65	0.000
16	4.439	0.000	0.000	69	0.000
17	4.221	2.796	1.331	78	0.315
18	2.945	1.523	0.692	80	0.235
19	4.576	3.957	1.560	*	0.341
20	4.772	0.722	0.429	70	0.090
21	5.073	4.216	1.482	63	0.292
22	3.825	0.120	0.079	67	0.021
23	2.598	1.585	0.607	62	0.234
24	4.376	3.694	1.279	65	0.292
25	5.148	4.401	1.519	67	0.295
26	1.411	0.000	0.000	57	0.000
27	5.117	2.819	1.412	72	0.276
28	4.983	2.801	1.074	79	0.216
29	3.009	2.068	0.594	76	0.197
30	3.982	2.445	0.819	*	0.206
31	1.579	0.444	0.139	67	0.088
SUM	119.884	64.883	24.265	-	-
AVG	3.867	2.093	0.783	67	0.202
RESID	G001		G100		N100

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
STORAGE PERFORMANCE

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

DAY OF MONTH	ENERGY TO STORAGE MILLION BTU	ENERGY FROM STORAGE MILLION BTU	CHANGE IN STORED ENERGY MILLION BTU	STORAGE AVERAGE TEMP DEG F	STORAGE EFFICIENCY
1	0.083	0.142	-0.058	85	1.005
2	0.000	0.042	-0.143	81	1.000
3	0.364	0.077	1.062	104	3.125
4	0.729	0.265	0.512	134	1.066
5	0.284	0.310	-0.064	143	0.868
6	0.380	0.272	0.063	143	0.882
7	0.274	0.265	-0.042	143	0.815
8	0.226	0.208	-0.042	141	0.735
9	0.331	0.215	0.097	143	0.944
10	0.325	0.265	0.025	146	0.892
11	0.008	0.376	-0.450	137	-9.475
12	0.467	0.258	0.426	136	1.464
13	0.000	0.226	-0.422	137	1.000
14	0.000	0.118	-0.385	119	1.000
15	0.000	0.050	-0.263	104	1.000
16	0.000	0.023	-0.178	96	1.000
17	0.274	0.010	0.585	107	2.177
18	0.121	0.018	0.120	121	1.134
19	0.088	0.108	0.557	135	7.570
20	0.164	0.260	-0.208	140	0.320
21	0.573	0.291	0.331	144	1.086
22	0.027	0.294	-0.406	140	-4.189
23	0.135	0.219	-0.115	130	0.769
24	0.235	0.172	0.235	134	1.733
25	0.480	0.269	0.351	146	1.292
26	0.000	0.408	-0.510	143	1.000
27	0.545	0.204	0.228	135	0.793
28	0.101	0.188	0.146	146	3.292
29	0.008	0.189	-0.213	141	-3.125
30	0.130	0.169	0.028	140	1.515
31	0.026	0.219	-0.300	133	-3.055
SUM	6.377	6.132	0.966	-	-
AVG	0.206	0.198	0.031	130	1.113
NBS ID	G200	G201	G202		N108

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
HOT WATER SUBSYSTEM

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

DAY OF MON.	HOT WATER LOAD MILLION BTU	SOLAR FR.OF LOAD PER CENT	SOLAR ENERGY USED MILLION BTU	OTHER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	SUP. WAT. TEMP DEG F	HOT WAT. TEMP DEG F	HOT WATER USED GAL
1	0.023	30	0.031	0.004	0.032	0.032	N	0.007	N	55	130	43
2	0.021	20	0.000	0.000	0.043	0.043	O	0.008	O	59	130	34
3	0.000	10	0.132	0.016	0.028	0.028	T	-0.016	T	48	142	0
4	0.000	6	0.097	0.016	0.015	0.015		-0.016		48	142	0
5	0.000	3	0.118	0.010	0.030	0.030	A	-0.010	A	48	142	0
6	0.013	30	0.110	0.011	0.018	0.018	P	0.004	P	49	142	17
7	0.002	41	0.074	0.010	0.015	0.015	P	0.001	P	68	96	15
8	0.000	24	0.078	0.008	0.018	0.018	L	-0.008	L	71	90	0
9	0.000	15	0.093	0.012	0.014	0.014	I	-0.012	I	71	90	0
10	0.014	34	0.087	0.010	0.019	0.019	C	0.004	C	64	111	19
11	0.047	26	0.006	0.000	0.071	0.071	A	0.020	A	54	139	75
12	0.030	31	0.185	0.016	0.044	0.044	B	0.006	B	56	132	50
13	0.031	30	0.015	0.000	0.063	0.063	L	0.013	L	53	140	44
14	0.019	19	0.010	0.000	0.090	0.090	E	0.008	E	62	109	43
15	0.046	18	0.051	0.000	0.091	0.091		0.013		53	135	62
16	0.015	10	0.029	0.000	0.092	0.092		0.005		57	135	26
17	0.000	3	0.118	0.011	0.035	0.035		-0.011		53	119	0
18	0.000	1	0.083	0.007	0.038	0.038		-0.007		53	119	0
19	0.081	45	0.173	0.014	0.060	0.060		0.058		56	134	123
20	0.039	45	0.085	0.004	0.054	0.054		0.025		54	142	54
21	0.032	44	0.158	0.014	0.044	0.044		0.014		55	142	43
22	0.091	45	0.045	0.001	0.121	0.121		0.052		54	139	141
23	0.031	46	0.109	0.008	0.061	0.061		0.030		53	140	47
24	0.053	56	0.164	0.015	0.024	0.024		0.030		56	138	83
25	0.009	41	0.128	0.015	0.039	0.039		-0.009		55	142	12
26	0.000	14	0.011	0.000	0.075	0.075		0.000		54	142	0
27	0.037	22	0.204	0.009	0.064	0.064		0.015		54	142	52
28	0.066	60	0.189	0.010	0.028	0.028		0.056		57	138	101
29	0.026	56	0.131	0.010	0.039	0.039		0.014		55	142	36
30	0.013	41	0.155	0.011	0.032	0.032		0.002		55	142	18
31	0.037	56	0.044	0.004	0.042	0.042		0.024		61	133	68
SUM	0.777	-	2.913	0.248	1.439	1.439	N.A.	0.321	N.A.	-	-	1207
AVG	0.025	40	0.094	0.008	0.046	0.046	N.A.	0.010	N.A.	56	131	39
NBS	Q302	N300	Q300	Q303	Q301	Q305	Q306	Q311	Q313	N305	N307	N308

* DENOTES UNAVAILABLE DATA.
@ DENOTES NULL DATA.
N.A. DENOTES NOT APPLICABLE DATA.

SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
SPACE HEATING SUBSYSTEM

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY,1979

SOLAR/2003-79/05

DAY OF MON.	SPACE HEATING LOAD MILLION BTU	SOLAR FR.OF LOAD PCT	SOLAR ENERGY USED MILLION BTU	OPER ENERGY MILLION BTU	AUX THERMAL USED MILLION BTU	AUX ELECT FUEL MILLION BTU	AUX FOSSIL FUEL MILLION BTU	ELECT ENERGY SAVINGS MILLION BTU	FOSSIL ENERGY SAVINGS MILLION BTU	BLDG TEMP DEG. F	AMB TEMP DEG. F
1	0.286	100	0.286	0.007	0.000	N	0.000	-0.007	0.476	63	47
2	0.105	100	0.105	0.002	0.000	O	0.000	-0.002	0.174	62	53
3	0.451	100	0.451	0.001	0.000	T	0.000	-0.001	0.752	65	50
4	0.660	100	0.652	0.001	0.000		0.000	-0.001	1.086	69	50
5	0.562	100	0.562	0.000	0.000	A	0.000	0.000	0.937	69	56
6	0.585	100	0.585	0.000	0.000	P	0.000	0.000	0.975	71	63
7	0.576	100	0.576	0.001	0.000	P	0.000	-0.001	0.960	74	68
8	0.463	100	0.463	0.000	0.000	L	0.000	0.000	0.771	76	76
9	0.545	100	0.545	0.000	0.000	I	0.000	0.000	0.908	78	76
10	0.583	100	0.583	0.001	0.000	C	0.000	-0.001	0.971	79	74
11	0.376	100	0.376	0.000	0.000	A	0.000	0.000	0.626	69	46
12	0.616	100	0.616	0.001	0.000	B	0.000	-0.001	1.027	72	52
13	0.375	100	0.375	0.000	0.000	L	0.000	0.000	0.624	72	58
14	0.302	100	0.302	0.000	0.000	E	0.000	0.000	0.503	71	57
15	0.174	100	0.174	0.000	0.000		0.000	0.000	0.290	71	58
16	0.116	100	0.116	0.000	0.000		0.000	0.000	0.193	70	61
17	0.325	100	0.325	0.000	0.000		0.000	0.000	0.542	73	72
18	0.341	100	0.341	0.000	0.000		0.000	0.000	0.569	75	69
19	0.560	100	0.560	0.001	0.000		0.000	-0.001	0.934	75	63
20	0.388	100	0.388	0.000	0.000		0.000	0.000	0.646	75	61
21	0.609	100	0.609	0.000	0.000		0.000	0.000	1.014	75	56
22	0.337	100	0.337	0.000	0.000		0.000	0.000	0.561	74	61
23	0.411	100	0.411	0.000	0.000		0.000	-0.000	0.685	72	56
24	0.555	100	0.555	0.001	0.000		0.000	-0.001	0.924	73	56
25	0.631	100	0.631	0.001	0.000		0.000	-0.001	1.051	75	58
26	0.440	100	0.440	0.000	0.000		0.000	0.000	0.733	72	55
27	0.517	100	0.517	0.001	0.000		0.000	-0.001	0.862	75	62
28	0.510	100	0.510	0.000	0.000		0.000	-0.000	0.850	78	69
29	0.480	100	0.480	0.000	0.000		0.000	0.000	0.801	77	70
30	0.418	100	0.418	0.000	0.000		0.000	0.000	0.696	80	75
31	0.273	100	0.273	0.001	0.000		0.000	-0.001	0.454	75	63
SUM	13.567	-	13.558	0.018	0.000	N.A.	0.000	-0.018	22.597	-	-
AVG	0.438	100	0.437	0.001	0.000	N.A.	0.000	-0.001	0.729	73	61
NBS	Q402	N400	Q400	Q403	Q401		Q410	Q415	Q417	N406	N113

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SOLAR HEATING AND COOLING DEMONSTRATION PROGRAM

MONTHLY REPORT
ENVIRONMENTAL SUMMARY

SITE: SCATTERGOOD SCHOOL
REPORT PERIOD: MAY, 1979

SOLAR/2003-79/05

DAY OF MONTH	TOTAL INSOLATION BTU/SQ.FT	DIFFUSE INSOLATION BTU/SQ.FT	AMBIENT TEMPERATURE DEG F	DAYTIME AMBIENT TEMP DEG F	RELATIVE HUMIDITY PERCENT	WIND DIRECTION DEGREES	WIND SPEED M.P.H.
1	1021	N	47	50	*	0	0
2	154	C	53	54	*	0	0
3	1989	T	50	54	*	0	0
4	2066		50	58	*	0	0
5	1841	A	56	63	*	0	0
6	1867	F	63	71	*	0	0
7	1692	F	68	75	*	0	0
8	1528	L	76	81	*	0	0
9	1729	I	76	82	*	0	0
10	1549	C	74	82	*	0	1
11	579	A	46	46	*	0	0
12	2092	E	52	58	*	0	0
13	1923	L	58	66	*	0	0
14	1131	E	57	60	*	0	1
15	2008		58	65	*	0	0
16	1778		61	69	*	0	0
17	1691		72	78	*	0	0
18	1181		69	80	*	0	0
19	1833		63	*	*	0	0
20	1912		61	70	*	0	0
21	2032		56	63	*	0	0
22	1532		61	67	*	0	0
23	1041		56	62	*	0	0
24	1753		56	65	*	0	0
25	2062		58	67	*	0	0
26	565		55	57	*	0	1
27	2050		62	72	*	0	0
28	1996		69	79	*	0	0
29	1205		70	76	*	0	0
30	1595		75	*	*	0	0
31	633		63	67	*	0	0
SUM	48031	N.A.	-	-	-	-	-
AVG	1549	N.A.	61	67	*	0	0
NBS ID	0001		N113			N115	N114

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*U.S. GOVERNMENT PRINTING OFFICE: 1979-640-189/4204. Region 4.